CLAIMS

1. A method for purifying metal M_1 particles manufactured by an electrochemical reduction process, the method comprising the steps of :

introducing the metal M_1 particles into a heat source at a temperature substantially equal to or higher than the melting point of M_1 so as to cause vaporisation of some or substantially all of the contaminating impurities present;

removing the vaporised impurities from the vicinity of the particles;

and cooling the purified metal M_1 particles.

2. A method for the manufacture of a metal alloy article containing a metal M_1, comprising the steps of:

electrochemically reducing a source of a compound of the general formula M_1X to remove substantially all of element X and provide powder particles consisting substantially of metal M_1;

introducing the metal powder M_1 into a heat source at a temperature substantially equal to or higher than melting point of M_1 for a period of time sufficient to cause vaporisation of a significant proportion of the one or more impurities;

removing the vaporised impurities;

cooling the purified metal M_1 powder; and

mixing the purified M_1 powder with powder of other alloy components and performing a powder metallurgy process on the mixture to form the alloyed article.

3. A method as claimed in claim 1 wherein the particles are in the form of a powder.

4. A method as claimed in claim 2 wherein the powder metallurgy process involves powder sintering.

5. A method as claimed in claim 2 wherein the powder metallurgy process involves powder pressing or forging.

6. A method as claimed in any preceding claim wherein the heat source is selected from any one of a plasma torch, a laser, an electric arc, an induction coil or a tube furnace.

7. A method as claimed in any preceding claim, wherein the method is conducted in a controlled atmosphere.

8. A method as claimed in any preceding claim, wherein a further purification step comprises water or acid washing and drying of the powder.

9. A method as claimed in any preceding claim conducted in apparatus comprising a heat source, collection means for collecting the purified particles, and separate collection means for collecting the impurities.

10. A method as claimed in any preceding claim wherein the particles are suspended in mid-air and/or permitted to free fall past or within the heat source.

11. A method as claimed in claim 10 wherein the free fall distance from the heat source is sufficiently long to allow any M_1 melted by the heat source to re-solidify before collection.

12. A method as claimed in claim 6 wherein the heat source is a plasma torch and

the step of removing the vaporised impurities involves allowing the impurities to be swept away by the hot gas flow from the torch.

13. A method as claimed in any of claims 1 to 11 wherein the step of removing the vaporised impurities involves condensing the vaporised impurities on cold collector plates positioned adjacent the heat source and disposing of the condensed impurities.

14. A method as claimed in any preceding claim wherein the temperature of the heat source is around or above the melting point, but below the boiling point of M_1.

15. A method for purifying a piece of metal M_1 having at least one dimension of 1mm or less in size and manufactured by an electrochemical reduction method, the metal M_1 containing impurities with a boiling point below the boiling point of M_1 comprising the steps of:

treating a planar surface of the piece of metal at a temperature substantially equal to or higher than the boiling point of the one or more impurities to be removed but below the boiling point of M_1 for a period of time sufficient to cause vaporisation of a significant proportion of the one or more impurities present;

removing the vaporised impurities; and

cooling the purified metal piece.

16. A method as claimed in any preceding claim wherein M_1 comprises titanium.

17. A method as claimed in any of claims 2 to 16 wherein M_1X is titanium oxide TiO_2.

18. A method as claimed in any preceding claim wherein the impurities comprise

one or more of magnesium, calcium and calcium chloride.

19. A method for the manufacture of a metal alloy article of uniform cross section comprising the steps of:

introducing a continuous source of metal alloy M_1 pellets, manufactured by an electrochemical reduction process, to a processing means;

heating the pellets as they approach the processing means, by free-fall through a heat source, to a temperature substantially equal to or higher than the melting point of M_1 so as to cause vaporisation of some or substantially all of the contaminating impurities present;

removing the vaporised impurities from the vicinity of the pellets;

drawing the metal through the processing means so as to coalesce the pellets to form the desired article; and,

cooling the cast stock.

20. A method as claimed in claim 19 for the manufacture of a metal alloy sheet comprising the steps of:

introducing the continuous source of pellets to a pair of cooled feed rollers;

heating the pellets as specified in claim 19 as they approach the nip of the pair of feed rollers;

drawing the metal through the nip of the rollers to form a sheet of metal alloy; and,

cooling the sheet.

21. A method as claimed in claim 20, wherein either or both of the rollers are cooled.

22. A method as claimed in claim 21, wherein the rollers are cooled by a coolant continuously flowing through their centre.

23. A method as claimed in claim 22, wherein the coolant is water.

24. A method as claimed in claim 19 for the manufacture of a uniform cross-section metal alloy stock, comprising the steps of:

introducing the continuous source of pellets of the metal alloy to a shaped crucible;

heating the pellets as specified in claim 19 as they approach the exposed surface of the crucible;

drawing the at least partially molten metal from an opposing surface of the crucible through a die, the die having a cross section of near net shape and dimensions to the desired net shape and dimensions of the required stock; and,

cooling the cast stock.

25. A method as claimed in any of claims 19 to 24, wherein the step of heating the pellets is carried out by means of an energy beam selected from an electron beam, a laser or a plasma torch.

26. A method as claimed in any of claims 20 to 25, wherein the sheet or stock is submitted to additional metal working or heat treatment processes prior to cooling.

27. A method as claimed in any of claims 19 to 26, wherein the alloy substantially comprises titanium.

28. A method substantially as described herein and with reference to any one of Figures 1 to 7.

29. Metal particles or a metal alloy article manufactured according to the method of any preceding claim.

30. A metal alloy article substantially as described herein and with reference to Figures 1 to 7.